

Neurological Benefits of Mindfulness

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René Descartes was a 17th-century philosopher who popularized the idea of Cartesian dualism, an abstract separation between the body and the mind, heavily influencing modern thought. People tend to think of their mind as separate from their brain and body, hence the term “Mind over matter”. Descartes believed that the connection between the mind and brain occurred at the pineal gland, which he called the “seat of the soul”. Because we now know that the pineal gland is responsible for secretion of melatonin, a chemical that contributes to the regulation of our circadian rhythm, we can now understand that this differs from the definition that it was the area where all our thoughts are formed. Additionally, from a biological standpoint, the “mind” as thought and abstract ideas originate from electrical and chemical signals in the brain (Lockhorst, 2013).

There is no separation between mind and body, for the brain works independently and outside of the body. The brain is simply another organ that functions as a piece of a machine, though the mechanisms are anything but simple. As a small error in syntax could lead to a myriad of unforeseen malfunctions in a computer program, minor changes in brain chemistry could lead to serious defects in the rest of the body. Studies have shown that chronic stress strongly correlates to psychological disorders, decreased function in learning and attention, and weakening of the immune system (Schneiderman, Ironson, & Siegel, 2008). However, for every action there is an equal and opposite reaction - the opposing process is mindfulness meditation, a technique that correlates with improvement in health. Effects have been most notable in patients with anxiety and depression, enhancing attention and reducing the risk of future cardiac ailments.

Mindfulness has proven to be quite an effective remedy in western medicine, despite its distant origin in Eastern Culture over two millennia ago. The practice of mindfulness, nonjudgmentally focusing the attention on the present moment to achieve mental clarity, originated in the Hindu traditions of Vedantism. Other methods of practicing mindfulness later developed with Buddhism around 400 B.C.E. The practice traveled West when Jon Kabat-Zinn, a medical professor, started the Mindfulness-

Based Stress Reduction Clinic in Massachusetts. Mindfulness plays a large role in positive psychology, which focuses on people’s strengths and needs for fulfillment. Once mindfulness and detailed brain-imaging technology became prevalent in medicine, the door for research was opened. (Joaquin, 2017)

When researching emotion, fear is the easiest to observe. This is because behaviors associated with fear, such as cowering or running away, are physically exhibited. Fear is a strong emotion and necessary for survival, although it can become pervasive and interfere with everyday functioning. When this happens, it is a sign that a person may be suffering from an anxiety disorder. According to the National Comorbidity Survey by Harvard Medical School (Harvard Medical School, 2007), anxiety disorders are the most common psychological disorders in the United States.

Many medications and treatments for anxiety disorders are used to avoid feelings of fear, but mindfulness takes the approach of confronting and accepting them. Some people believe that focusing on the inner experience in a non-judgmental way can ease discomfort and promote a positive relationship with emotion. (Greeson & Brantley, 2009) Studies have found that it is very likely these people are correct in their hypothesis. According to Hofmann, practicing mindfulness over the short course of two months was found to reduce symptoms of panic and anxiety (Hedges’ $g= .97$). Mindfulness therapy could be another option as an alternative or addition to medication for anxiety and panic disorders. In a 3-year follow-up, 22 patients who had undergone an 8-week mindfulness-based stress reduction outpatient study were found to have maintained their stress reduction, measured on the Hamilton anxiety scale ($F(2,32) = 13.22; p < 0.001$) (Miller, Fletcher, & Kabat-Zinn, 1995).

The anterior cingulate cortex (ACC), associated with attention, is the brain area most consistently related to mindfulness during studies. The ACC functions to filter out distractions and direct attention to the object of focus. It was also found that the ACC is responsible for sustained attention (Wu et al, 2017). The fronto-limbic structures of the brain that control stress reduction and emotional regulation are also involved. Areas associated

with attention and emotional regulation in the cerebral cortex were thicker in mindfulness practitioners compared to those who had never practiced this form of meditation. (Tang, Holzel, & Posner, 2015).

Depression is the second most prevalent psychological disorder the US population faces. Incredibly, mindfulness meditation not only lowers the feelings of fear in those with anxiety disorders but also raises the quality of life in patients with depression. As with anxiety, mindfulness meditation is helpful in symptom reduction, it’s unclear as to what neural mechanisms are responsible. More research is needed in these areas for full comprehension, but we do know a few of the brain areas involved as of now. The insula was found to have reduced activation during exposure to negative stimuli in those who practiced mindfulness. This brain area plays a large role in emotional experience and the decrease in activity corresponds to a decrease in rumination, a symptom of depression (Paul, Stanton, Greeson, Smoski, & Wang, 2012). Mindfulness-based cognitive therapy has been shown to reduce symptoms and prevent relapse of depression ($p=0.04$), though more research needs to be done on the neurological basis of these results (Barnhofer et al, 2009).

A benefit of mindfulness that is relatively well established is that the practice enhances attention (Tang et al, 2015). According to Lin et. al., “Results reveal that mindfulness as a meditative practice produced a reduction in the difference between the LPP response to negative high arousing and neutral stimuli across time” (Lin, Fisher, Roberts, & Moser, 2016). This means attention will be higher for more mental tasks, like studying, in addition to ones that automatically capture our attention, like video games. Studies have shown improved attention in long-term meditators. The cognitive decline that comes with age is reduced in these people, due to maintenance of the anterior cingulate cortex through meditation (Zanesco, King, MacLean, & Saron, 2018).

There is a strong connection to regulating breath and regulating attention. Focused breathing is a method of mindfulness meditation that requires sustained attention to the body and present moment. This is likely the most practiced form of meditation and it has long-term benefits

on attention and stress. Emotions, focus, and memory become clearer with this practice. Breathing directly affects our attention, which cycles with each inhalation and exhalation. Inhaling correlates to higher attention, exhaling to lower. Mindful breathing works to reduce noradrenaline to a “sweet spot.” Too much noradrenaline can cause a jittery, nervous feeling while feelings of sluggishness may result when insufficient amounts are present. This mechanism reduces stress long-term, which benefits other areas of the body (Melnichuk et al, 2018).

Stroke is the fifth biggest killer in the US and heart disease is number one. Chronic stress is a risk factor for both. Those who suffer from chronic stress have high levels of cortisol, a stress hormone, which increases blood pressure. Increased blood pressure for long periods of time increases the risk of heart disease and stroke. Corticosteroid is another stress hormone as it. It suppresses the immune system by blocking the transcription of cytokines, proteins which regulate inflammation and immunity. Immunosuppression is the result of this chain of events, leading to adverse health issues over time. Suppression of the immune system impacts every system of the body and is linked to diseases like osteoporosis and obesity (Barshes, Goodpastor, & Goss, 2004). Acute, short-term stress is adaptive and will increase immune function, but chronic stress suppresses it (Dhabhar, 2009). Mindfulness meditation and focused breathing can be preventative for chronic stress, thereby reducing the risk of stroke and heart disease.

Although there is a need for more research on the neurologic mechanisms behind the benefits of mindfulness meditation, the studies given here show evidence that some benefits may exist. With age, decline in the ability to learn, solve problems, and reason is an issue common throughout all of humanity. Depression and anxiety are the most common mental disorders in the US. Stroke and heart disease are some of the top killers in our country. Mindfulness meditation is a method that has been found to reduce the symptoms of or prevent these ailments entirely. Additionally, it has been around for thousands of years due to its health benefits. Combined with new technology, increased understanding of the brain, and modern approaches to medicine, this practice could become more prevalent as a simple, natural treatment for many diseases.

Notes

1 LLP stands for Late Positive Potential. It is an electrophysiological measure of attention given to emotional stimuli.

2 Hedges' G is a statistical test measuring size of an effect, or how much one group differs from another. G is indicative of the number of standard deviations the groups differ by. For reference, $g=.2$ is considered a small effect and $g=.8$ is considered a large effect.

References

Barnhofer, T., Crane, C., Hargus, E.,

Amarasinghe, M., Winder, R. J., & Williams, M. G. (2009, February 05). Mindfulness-based cognitive therapy as a treatment for chronic depression: A preliminary study. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0005796709000333>

Barshes, N. R., Goodpastor, S. E., & Goss, J. A. (2004, January 01). Pharmacologic immunosuppression. Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/14766378>

Dhabhar, F. S. (2009, June 29). Enhancing versus Suppressive Effects of Stress on Immune Function: Implications for Immunoprotection and Immunopathology. Retrieved from <https://www.karger.com/Article/Abstract/216188>

Greeson J., Brantley J. (2009) Mindfulness and Anxiety Disorders: Developing a Wise Relationship with the Inner Experience of Fear. In: Didonna F. (eds) *Clinical Handbook of Mindfulness*. Springer, New York, NY

Harvard Medical School, 2007. National Comorbidity Survey (NCS). (2017, August 21). Retrieved from <https://www.hcp.med.harvard.edu/ncs/index.php>. Data Table 1: Lifetime prevalence DSM-IV/WMH-CIDI disorders by sex and cohort.

Hofmann SG, Sawyer AT, Witt AA, Oh D. The effect of mindfulness-based therapy on anxiety and depression: A meta-analytic review. *J Consult Clin Psychol*. 2010;78(2):169–183.

J. (2017, March 13). History of Mindfulness: From East to West and From Religion to Science. Retrieved from <https://positivepsychologyprogram.com/history-of-mindfulness/#hinduism-mindfulness>

Lin, Y., Fisher, M. E., Roberts, S. M., & Moser, J. S. (2016, August 26). Deconstructing the Emotion Regulatory Properties of Mindfulness: An Electrophysiological Investigation. Retrieved from <https://www.frontiersin.org/articles/10.3389/fnhum.2016.00451>

Lokhorst, G. (2013, September 18). Descartes and the Pineal Gland. Retrieved from <https://plato.stanford.edu/entries/pineal-gland/>

Melnichuk, M. C., Dockree, P. M., O'Connell, R. G., Murphy, P. R., Balsters, J. H., & Robertson, I. H. (2018, April 22). Coupling of respiration and attention via the locus coeruleus: Effects of meditation and pranayama. Retrieved from https://onlinelibrary.wiley.com/doi/epdf/10.1111/psyp.13091?referrer_access_token=t9lStfeplDGu6jOVeu3YLIta6bR2k8jH0KrdpFOxC65T4Ao_I-grzhs0tmVptUd527u1llRrf9izg5qUbsQljTEj9qnmg00JJkVOfg4nGoD_0Q1KKvdbGbeNWNq_NrGS

Miller, J. J., Fletcher, K., & Kabat-Zinn, J. (1999, December 28). Three-year follow-up and clinical implications of

a mindfulness meditation-based stress reduction intervention in the treatment of anxiety disorders. Retrieved from <https://www.sciencedirect.com/science/article/pii/S016383439500025M>

Paul, N. A., Stanton, S. J., Greeson, J. M., Smoski, M. J., & Wang, L. (2012, October 14). Psychological and neural mechanisms of trait mindfulness in reducing depression vulnerability. Retrieved from <https://academic.oup.com/scan/article/8/1/56/1696427>

Schneiderman, N., Ironson, G., & Siegel, S. D. (2008, October 16). Stress and Health: Psychological, Behavioral, and Biological Determinants. Retrieved January 30, 2019, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2568977/>

Tang, Y., Hölzel, B. K., & Posner, M. I. (2015, March 18). The neuroscience of mindfulness meditation. Retrieved from <https://www.nature.com/articles/nrn3916>

Wu, Dingcheng & Deng, Hanfei & Xiao, Xiong & Zuo, Yanfang & Sun, Jingjing & Wang, Zuoren. (2017). Persistent Neuronal Activity in Anterior Cingulate Cortex Correlates with Sustained Attention in Rats Regardless of Sensory Modality. *Scientific Reports*. 7. 43101. 10.1038/srep43101.

Zanesco, A. P., King, B. G., MacLean, K. A., & Saron, C. D. (2018, March 28). Cognitive Aging and Long-Term Maintenance of Attentional Improvements Following Meditation Training. Retrieved from <https://link.springer.com/article/10.1007/s41465-018-0068-1>